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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
WILSON, CHRISTIAN D	

ART UNIT	PAPER NUMBER
2824	

DATE MAILED: 12/31/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/020,663	SIN ET AL.	
	Examiner	Art Unit	
	Christian Wilson	2824	

-- Th MAILING DATE of this communication appears on the cover sheet with the correspond nce address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 October 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-59* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-59* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *14 December 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *2*.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☒ Other: *search history*.

DETAILED ACTION

Election/Restrictions

1. Applicant's election of claims 1 – 59 in Paper No. 4 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

2. Applicant's amendment of October 2, 2003 has been entered, and claims 60 – 88 have been cancelled.

Drawings

3. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the antiferromagnetic layer, two ferromagnetic layers separated by a spacer layer, and two ferromagnetic layers forming the free layer must be shown or the features canceled from the claims. No new matter should be entered.

A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 37, 39, 40, 42, 45, and 46 are rejected under 35 U.S.C. 102(e) as being anticipated by Durlam *et al.*

Regarding claim 37, Durlam *et al.* discloses an MRAM cell comprising a magnetic tunneling junction including a free layer **42**, a pinned layer **40**, an insulating spacer layer **41** between the free and pinned layer, a digit line **29** including a segment **45** proximate to the pinned layer and having a long axis defining a first direction, a bit line including a segment **48** in electrical contact with the free layer and having a long axis defining a second direction perpendicular to the first direction [Figure 9], a bottom surface abutting the free layer [Figure 9], a top surface opposite the bottom surface [Figure 9], and a first and second vertical surfaces opposite one another and connecting the top and bottom surfaces [Figure 9], and a magnetic liner layer **56, 58** disposed around the bit line segment and contacting the first and second vertical surfaces and the top surface.

Regarding claim 39, Durlam *et al.* further discloses a magnetic liner layer which is electrically conductive [column 5, lines 1-5].

Regarding claim 40, Durlam *et al.* further discloses a bit and digit line formed of Cu, W, or Al [column 3, line 44; column 5, line 9].

Regarding claim 42, Durlam *et al.* further discloses a magnetic liner layer formed of permalloy [column 5, line 5].

Regarding claim 45, Durlam *et al.* further discloses a magnetic liner layer with a thickness of 20 – 200 Å [column 4, line 32].

Regarding claim 46, Durlam *et al.* further discloses a magnetic liner layer with a thickness of 20 – 200 Å [column 4, line 32].

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 1, 2, 4, 5, 7, 10, 11, 15 – 17, 19, 22, 23, 26 – 28, 30, 33, 34, 38, 49 – 51, 53, 56, and 57 are rejected under 35 U.S.C. 103(a) as being unpatentable over Durlam *et al.* in view of Schwarzl.

Regarding claim 1, Durlam *et al.* (US 6,174,737) teaches an MRAM cell comprising a magnetic tunneling junction including a free layer **42**, a pinned layer **40**, a spacer layer **41** between the free and pinned layer, a digit line **29** including a bit line segment **45** proximate to the magnetic tunneling junction, a bit line including a bit line segment **48** in electrical contact with the magnetic tunneling junction, and a magnetic liner layer **56, 58** disposed around the bit line segment. Durlam *et al.* does not teach a magnetic liner layer contacting the free layer. Schwarzl (US 6,510,078) teaches a magnetic liner layer which contacts the free layer [Figure 8]. It would have been obvious to one of ordinary skill in the art to contact the free layer with the magnetic liner layer since Schwarzl teaches this configuration forms a reinforced magnetic field at the location of the memory element [column 4, lines 60-67].

Regarding claim 2, Durlam *et al.* further teaches a digit line segment disposed proximate to the pinned layer and a bit line segment in electrical contact with the free layer [Figure 8].

Regarding claim 4, Durlam *et al.* further teaches a magnetic liner layer which is electrically conductive [column 5, lines 1-5].

Regarding claim 5, Durlam *et al.* further teaches a bit and digit line formed of Cu, W, or Al [column 3, line 44; column 5, line 9].

Regarding claim 7, Durlam *et al.* further teaches a magnetic liner layer formed of permalloy [column 5, line 5].

Regarding claim 10, Durlam *et al.* further teaches a magnetic liner layer with a thickness of 20 – 200 Å [column 4, line 32].

Regarding claim 11, Durlam *et al.* further teaches a magnetic liner layer with a thickness of 20 – 200 Å [column 4, line 32].

Regarding claim 15, Durlam *et al.* teaches an MRAM cell comprising a magnetic tunneling junction including a free layer **42** having a magnetization orientation [column 1, lines 19-35], a pinned layer **40**, an insulating spacer layer **41** between the free and pinned layer, a digit line **29** including a bit line segment **45** proximate to the magnetic tunneling junction, a bit line including a bit line segment **48** in electrical contact with the magnetic tunneling junction, and a magnetic liner layer **56, 58** disposed around the bit line segment. Durlam *et al.* does not teach a magnetic liner layer contacting the free layer. Schwarzl teaches a magnetic liner layer which contacts the free layer [Figure 8] such that a magnetic field encircles the bit line segment. It would have been obvious to one of ordinary skill in the art to contact the free layer with the

magnetic liner layer since Schwarzl teaches this configuration forms a reinforced magnetic field at the location of the memory element [column 4, lines 60-67].

Regarding claim 16, Durlam *et al.* further teaches a magnetic liner layer which is electrically conductive [column 5, lines 1-5].

Regarding claim 17, Durlam *et al.* further teaches a bit and digit line formed of Cu, W, or Al [column 3, line 44; column 5, line 9].

Regarding claim 19, Durlam *et al.* further teaches a magnetic liner layer formed of permalloy [column 5, line 5].

Regarding claim 22, Durlam *et al.* further teaches a magnetic liner layer with a thickness of 20 – 200 Å [column 4, line 32].

Regarding claim 23, Durlam *et al.* further teaches a magnetic liner layer with a thickness of 20 – 200 Å [column 4, line 32].

Regarding claim 26, Durlam *et al.* teaches an MRAM cell comprising a magnetic tunneling junction including a free layer **42**, a pinned layer **40**, an insulating spacer layer **41** between the free and pinned layer, a digit line **29** including a segment **45** proximate to the pinned layer and having a long axis defining a first direction, an electrically insulating spacer layer **33** disposed between the digit line segment and pinned layer, a bit line including a bit line segment **48** in electrical contact with the free layer and having a long axis defining a second direction perpendicular to the first direction [Figure 9], and a magnetic liner layer **56, 58** disposed around the bit line segment. Durlam *et al.* does not teach a magnetic liner layer contacting the free layer. Schwarzl teaches a magnetic liner layer which contacts the free layer [Figure 8]. It would have been obvious to one of ordinary skill in the art to contact the free layer with the magnetic

liner layer since Schwarzl teaches this configuration forms a reinforced magnetic field at the location of the memory element [column 4, lines 60-67].

Regarding claim 27, Durlam *et al.* further teaches a magnetic liner layer which is electrically conductive [column 5, lines 1-5].

Regarding claim 28, Durlam *et al.* further teaches a bit and digit line formed of Cu, W, or Al [column 3, line 44; column 5, line 9].

Regarding claim 30, Durlam *et al.* further teaches a magnetic liner layer formed of permalloy [column 5, line 5].

Regarding claim 33, Durlam *et al.* further teaches a magnetic liner layer with a thickness of 20 – 200 Å [column 4, line 32].

Regarding claim 34, Durlam *et al.* further teaches a magnetic liner layer with a thickness of 20 – 200 Å [column 4, line 32].

Regarding claim 38, Durlam *et al.* teaches the limitations of claim 37 as described above, but does not teach a magnetic liner layer which contacts the free layer. Schwarzl teaches a magnetic liner layer which contacts the free layer [Figure 8]. It would have been obvious to one of ordinary skill in the art to contact the free layer with the magnetic liner layer since Schwarzl teaches this configuration forms a reinforced magnetic field at the location of the memory element [column 4, lines 60-67].

Regarding claim 49, Durlam *et al.* teaches an MRAM cell comprising a magnetic tunneling junction including a free layer **42**, a pinned layer **40**, an insulating spacer layer **41** between the free and pinned layer, a digit line **29** including a segment **45** proximate to the pinned layer and having a long axis defining a first direction, a bit line including a bit line segment **48** in

electrical contact with the free layer and having a long axis defining a second direction perpendicular to the first direction [Figure 9], and a magnetic sheath disposed around the bit line segment and formed from a magnetic liner layer **56, 58**. Durlam *et al.* does not teach a magnetic sheath formed of the free layer and magnetic liner layer. Schwarzl teaches a magnetic sheath which is formed of the free layer and magnetic liner layer [Figure 8]. It would have been obvious to one of ordinary skill in the art to form a sheath formed of the magnetic liner layer and free layer since Schwarzl teaches this configuration forms a reinforced magnetic field at the location of the memory element [column 4, lines 60-67].

Regarding claim 50, Durlam *et al.* further teaches a magnetic liner layer which is electrically conductive [column 5, lines 1-5].

Regarding claim 51, Durlam *et al.* further teaches a bit and digit line formed of Cu, W, or Al [column 3, line 44; column 5, line 9].

Regarding claim 53, Durlam *et al.* further teaches a magnetic liner layer formed of permalloy [column 5, line 5].

Regarding claim 56, Durlam *et al.* further teaches a magnetic liner layer with a thickness of 20 – 200 Å [column 4, line 32].

Regarding claim 57, Durlam *et al.* further teaches a magnetic liner layer with a thickness of 20 – 200 Å [column 4, line 32].

8. Claims 3, 6, 18, 29, 41, and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Durlam *et al.* and Schwarzl as applied to claims 1, 15, 26, 37, and 49 above, and further in view of applicant's prior art [APA].

Regarding claim 3, Durlam *et al.* as modified by Schwarzl teaches the limitations of claim 1 as described above, but they do not teach a bit line segment disposed proximate to the pinned layer and a digit line segment in electrical contact with the free layer. The applicant's admitted prior art teaches a bit line segment disposed proximate to the pinned layer and a digit line segment in electrical contact with the free layer [0007]. It would have been obvious to one of ordinary skill in the art to use the configuration taught by the APA in the device of Durlam *et al.* since applicant admits that this configuration is "well known in the art" [line 3].

Regarding claims 6, 18, 29, 41, and 52, Durlam as modified by Schwarzl teaches the limitations of claims 1, 15, 26, 37, and 49 as described above, but they do not teach an antiferromagnetic layer disposed adjacent to the pinned layer. The applicant's admitted prior art teaches an antiferromagnetic layer disposed adjacent to the pinned layer [0005]. It would have been obvious to one of ordinary skill in the art to use an antiferromagnetic layer disposed adjacent to the pinned layer since the applicant admits that this configuration is "well known in the art" [lines 11-12].

9. Claims 8, 9, 20, 21, 31, 32, 43, 44, 54, and 55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Durlam *et al.* and Schwarzl as applied to claims 1, 15, 26, 37, and 49 above, and further in view of Nishimura.

Durlam *et al.* as modified by Schwarzl teaches the limitations of claims 1, 15, 26, 37, and 49 as described above, but they do not teach a particular atomic percentage or chemical formulation for the permalloy. Nishimura (US 6,028,786) teaches a permalloy layer that has an atomic percentage of iron between 14 to 65 or a chemical formulation of $Ni_{81}Fe_{19}$ [column 8, lines 22-32]. It would have been obvious to one of ordinary skill in the art to use the permalloy

layer of Nishimura in the device of Durlam *et al.* since Nishimura teaches that these atomic percentages or chemical formulations are a preferable metal film for a magnetic layer in an MRAM cell [column 8, lines 16-22].

10. Claims 12, 14, 25, 36, 48, and 59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Durlam *et al.* and Schwarzl as applied to claims 1, 15, 26, 37, and 49 above, and further in view of Sato *et al.*

Durlam *et al.* as modified by Schwarzl teaches the limitations of claims 1, 15, 26, 37, and 49 as described above, but they do not teach a magnetic liner layer formed of one of the claimed materials. Sato *et al.* (US 5,986,858) teaches a magnetic liner layer formed of NiFe or FeN [column 17, line 28]. It would have been obvious to one of ordinary skill in the art to use FeN in the device of Durlam since Sato *et al.* teaches that FeN is an alternate choice for the NiFe of Durlam *et al.* when forming a magnetic liner layer.

Regarding claim 14, Durlam *et al.* as modified by Schwarzl does not teach two ferromagnetic layers. Sato *et al.* teaches a double layer of ferromagnetic material for the free layer [Figure 11]. It would have been obvious to one of ordinary skill in the art to use two ferromagnetic layers in Durlam *et al.* since this configuration provides an improved magnetoresistance ratio [column 6, lines 37-37].

11. Claims 13, 24, 35, 47, and 58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Durlam *et al.* and Schwarzl as applied to claims 1, 15, 26, 37, and 49 above, and further in view of Slaughter *et al.*

Durlam *et al.* as modified by Schwarzl teaches the limitations of claims 1, 15, 26, 37, and 49 as described above, but they do not teach two ferromagnetic layers separated by a spacer

layer. Slaughter *et al.* (US 6,205,052) teaches an MRAM device with two ferromagnetic layers separated by a spacer layer [column 7, lines 45-55]. It would have been obvious to one of ordinary skill in the art to use the configuration of Slaughter *et al.* in the device of Durlam *et al.* since this provides separation while allowing strong antiferromagnetic coupling.

Conclusion

12. A copy of the search history (EAST and STN) is enclosed .

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christian Wilson whose telephone number is (571) 272-1886. The examiner can normally be reached on weekdays, 7:30 AM to 4 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richard Elms can be reached on (571) 272-1869. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (571) 272-2800.

Christian Wilson, Ph.D.
Patent Examiner
Art Unit 2824

CDW